CLAIMS

1. An array disk system for use with a host device, comprising:

power source means providing current to said disk drives;

a plurality of disk drives in an array and each disk drive having at least one element that draws steady state current during normal operation and larger transient current during transitional operation from said power source means;

said elements including a plurality of disks mounted for steady state rotation about respective axes during normal operation and movable from rest to steady state operation rotation during transitional operation, and a plurality of heads being substantially stationary to the axis of rotations on the respective disks during steady state operation and movable radially relative to the axis of rotation of the corresponding disk during transitional operation;

means responsive to a signal commanding initiation of transient operation for a plurality of like ones said elements for offsetting the initiation of at least two transitional operations sufficiently so that their transitional operations do not overlap to a substantial extent and so that the transient current demands on said power source means are reduced over the transient current demands that would exist without the offsetting.

2. The array disk system according to claim 1, wherein identical ones of said elements are arranged in groups, with each group containing a plurality of said elements; and said means for offsetting offsets the initiation of the transitional operation between two groups.

3. The system of claim 2, further comprising:

means subdividing serial data to be written into a plurality of units of subdivided data; and

means for reading and writing the units of subdivided data in parallel with respect to the plurality of disk drives.

4. The system of claim 3, wherein said means for subdividing includes a sequencer means for dividing the data into a first plurality of subdivided data, a first plurality of buffers respectively receiving the first plurality of subdivided data, a plurality of second sequencers respectively further subdividing the subdivided data from said buffers, and a further plurality of buffers receiving the further subdivided data respectively and communicating with respective disk drives in parallel.

5. The system of claim 4, wherein said disk drives are divided into a plurality of parity groups, with each parity group including a plurality of said disk drives as data disk drives and a single disk drive as a parity disk drive; and

means for synchronizing the rotational speed of all the disk drives within a parity group with reference to one of the

disk drives within the parity group acting as a master disk.

6. A disk system for use with a host device, comprising:

a plurality of disk drives and each having a read head and a plurality of tracks;

controller means for controlling disk rotation, read head position and data processing, for conducting reading of data with respect to the host device and the individual disk drives;

said controller means varying the start of seek operations for moving the read heads to change the track positions at which the read heads are located so that peak seek operation current requirements do not substantially overlap to reduce maximum current requirements of the disk system.

7. The disk system according to claim 6, including indices provided on the disk drives as references for the start of data read and wherein said controller means includes means for rotation-synchronizing the disk drives such that position of the indices are offset among the disk drives.

8. The disk system according to claim 6, wherein said controller means deliberately offsets the seek operation start timing among the disk drives and said disks drives have aligned indices.

9. The array disk system according to claim 6, wherein said controller means varies timing of head addresses for the start of data read among the disks and said disk drives have aligned indices.

10. An array disk system for use with a host device, comprising:

a plurality of disk drives in an array and each having read/write heads;

controller means for controlling disk rotation read/write head position and data processing, for conducting parallel read/write of data by combining/subdividing data transferred with respect to the host device, and for simultaneously exchanging the subdivided data in parallel with respect to the individual disk drives;

said disk drives being subdivided into a plurality of parity groups; and

said controller means varying the start of seek operations for moving the read/write heads to change the track positions at which the read/write heads are located among at least some of the parity groups so that peak seek operation current requirements of the parity groups do not substantially overlap to reduce maximum current requirements of the array disk system.

11. The array disk system according to claim 10, wherein said controller means includes means for rotation-synchronizing the disk drives such that position of indices provided on the disk drives as references for the start of data read/write are offset among the parity groups.

12. The array disk system according to claim 11, wherein said controller means includes buffer means which store subdivided data simultaneously transferred to the respective parity groups and conducts offset read/write processing of the data relative to the disk drives in accordance with the positional offset of the indices.

13. The array disk system according to claim 10, wherein said controller means deliberately offsets the seek operation start timing among the groups and said disk drives have aligned indices.

14. The array disk system according to claim 10, wherein said controller means further varying head addresses for the start of data read/write among the groups and said disk drives have aligned indices on the disks among the groups.

15. The array disk system according to claim 10, wherein said controller means controls such that within each group the timing of the start of the seek operations is the same for all of the disk drives.

16. The array disk system according to claim 10, wherein said controller means controls such that within each group the timing of the start of the seek operations is offset among at least some of the disk drives.

17. The array disk system according to claim 16, wherein said disk drives have indices, as references for the start of data read/write, and said controller means includes means for rotation-synchronizing the disk drives with respect to the position of the indices.

18. The array disk system according to claim 10, wherein said controller means includes buffers storing subdivided data simultaneously transferred to the respective groups and conducts read/write processing of the data between the buffers and the groups in accordance with the positional offset of the indices.

19. The array disk system according to claim 10, wherein said disk drives have indices as references for the start of data read/write, and said controller means deliberately offsets the seek operation start timing among the disk drives of a group, without offsetting the positions of the indices on the disks.

20. The array disk system according to claim 10, wherein said disk drives have indices as references for the start of data read/write, and said controller means offsets the head addresses for the start of data read/write among the groups without offsetting the positions of the indices on the disks among the disk drives of a group.

21. In a method of controlling an array disk system to processes data in parallel among a plurality of disk drives;

controlling the array disk system so that seek operations for moving transducer heads to change track positions at which the transducer heads are positioned are prevented from

occurring simultaneously in at least some of the disk drives so that peak current requirements for seek of the at least some of the disk drives substantially do not overlap.

22. The method of controlling an array disk system according to claim 21, wherein said controlling includes offsetting the position of indices on the disks.

23. The method of controlling an array disk system according to claim 22 including dividing the disk drives into groups, each consisting of a plurality of the disk drives; and

said controlling is such that seek operation is prevented from occurring simultaneously among the groups, and seek operations commanded to simultaneously occur are controlled to occur in different groups at different times within the period of one disk revolution and all of the seek operations occurring at different times are completed within the same period of one disk revolution.

24. The method of controlling an array disk system according to claim 21, wherein said controlling includes offsetting the seek operation start timing among disk drives.

25. The method of controlling an array disk system according to claim 21, wherein said controlling includes offsetting head addresses for read/write starting among disk drives.

26. The method of controlling an array disk system according to claim 21, including dividing the large number of disk drives into groups, each group having a plurality of disk drives;

wherein said controlling prevents seek operation from occurring simultaneously among the groups; and

said controlling and dividing being such that seek operations start in different groups at different times within the period of a single disk revolution for all of the groups and all of the seek operations starting at different times are completed within the period of a single disk revolution.

27. A method of operating a disk system having a plurality of disk drives, comprising the steps of:

subdividing serial data to be written into a plurality of units of subdivided data;

reading and writing the units of subdivided data in parallel with respect to the plurality of disk drives;

driving the plurality of disk drives with a power source providing a steady state current during steady state driving of the disk drives;

dividing the disk drives into a plurality of start-up groups so that at least a first one of the start-up groups has a plurality of the disk drives;

at the time of power-on, starting up the first one of the start-up groups with current from the power source for a first period of time until the first start-up group attains a steady state condition;

at about the end of the first period of time, starting up a second one of the start-up groups with current from the power source for a second period of time until the second start-up group attains a steady state condition while continuing to rotate the first one of the start-up groups at steady state;

repeating the preceding step sequentially for the remaining, if any, start-up groups until all of the disk drives have attained steady state driving.

28. The method of claim 27, wherein said step of dividing provides the number of disk drives in the first start-up group to be equal to the total number of disk drives divided by the ratio of the initial current required by a single disk drive during start-up to the steady state current required by a single disk drive.

29. The method of claim 27, including:

designating a plurality of the disk drives as master disk drives;

during steady state, synchronizing rotation of the disk drives other than the master disk drives with the master disk drives; and

wherein said step of dividing forms the first one of the start-up groups to comprise at least all of the master disk drives.

30. The method of claim 27, including magnetically writing and reading data to and from magnetic disks respectively driven by the disk drives.

31. The method of claim 27, including optically reading data from optical disks respectively driven by the disk drives.

32. The method of claim 27, wherein said step of dividing is conducted such that the second one of the start-up group has less disk drives than the first one of the start-up groups.

33. The method of claim 32, wherein said step of dividing is conducted such that a third one of the start-up groups of disk drives has a less number of disk drives than the second one of the start-up groups of disk drives.

34. The method of claim 27, wherein said step of dividing is conducted so that each subsequent start-up group has a number of disk drives that is not greater than the number of disk drives in any preceding start-up group.

35. The method of claim 27, wherein said step of dividing determines the number of disk drives in each start-up group to be equal to (the current capacity of the power supply minus the steady state current of a single disk drive times the number of disk drives in a preceding start-up group, which have reached steady states) divided by (the start-up current required by a

single disk drive), rounded down to a whole integer.

36. The method of claim 35, wherein said step of dividing forms each start-up group with the maximum number of disk drives that can be started up in its time period so that the start-up current for the start-up group plus the steady state currents of the disk drives of preceding start-up groups does not exceed the current capacity of the power supply.

37. The method of claim 36, performed with respect to each of a plurality of power supplies and separate disk drives respectively connected to the power supplies in an array of disk drives and power supplies.

38. The method of claim 27, wherein said step of dividing forms each start-up group with the maximum number of disk drives that can be started up in its time period so that the start-up current for the start-up group plus the steady state currents of the disk drives of preceding start-up groups does not exceed the current capacity of the power supply.

39. The method of claim 27, wherein said step of subdividing the data passes the data through a sequencer to a plurality of first buffers, passes the data from each first buffer to a second sequencer, and divides the data in each second sequencer to subdata; and

passes each subdata through a separate buffer and logical control to a disk drive in parallel for all the subdata from at least the second sequencer.

40. The method of claim 39, further including steps of:

dividing the disk drives among a plurality of power groups for steady state driving to form an array disk system, which power groups are different from the start-up groups and so that each power group contains disk drives provided with data respectively from all of the second sequencers, so that all the disk drives are divided among the power groups without any one disk drive being in more than one power group and so that only one disk drive communicating subdata with a second sequencer is contained within one power group; and wherein

said subdividing, reading and writing, driving, dividing, starting up and repeating are conducted with respect to each of a plurality of power supplies and corresponding plurality of groups of the disk drives.

41. The method of claim 40, wherein said step of dividing provides the first start up group with a number of disk drives not exceeding the current capacity of the power supply divided by the ratio of start up current to steady state current of a single disk drive.

42. The method of claim 41, including parity dividing the disk drives into a plurality of parity groups so that the parity groups contain disk drives different from, respectively, the power groups.

43. The system of claim 27, wherein said step of dividing provides the number of disk drives in each start up group to not exceed the reserve current divided by the start up current of a single disk drive, wherein the reserve current is equal to the current capacity of the power supply minus the number of disk drives in prior start-up groups times the steady state current of a single disk drive.

44. The system of claim 43, including parity dividing th disk drives into a plurality of parity groups so that the parity groups contain disk drives different from, respectively, the start-up groups.

45. The system of claim 44, wherein each parity group includes a master disk and wherein said step of dividing the disk drives provides the first start-up group to contain all of the master disk drives.

46. The method of claim 44, including providing a plurality of power supplies, with each power supply supplying power to only a single disk drive of each and every parity group, and wherein said steps of subdividing, reading and writing, driving, dividing, starting up and repeating are conducted with respect to all the disk drives provided with power by each power supply.

47. The method of claim 27, wherein said step of dividing is conducted so that each subsequent start-up group has a number of disk drives that is not greater than the number of disk drives in any preceding start-up group;

said step of dividing determines the number of disk drives in each start-up group to be equal to (the current capacity of the power supply minus the steady state current of a single disk drive times the number of disk drives in a preceding start-up group, which have reached steady states) divided by (the start-up current required by a single disk drive), rounded down to a whole integer; and

said step of dividing forms each start-up group with the maximum number of disk drives that can be started up in its time period so that the start-up current for the start-up group plus the steady state currents of the disk drives of preceding start-up groups does not exceed the current capacity of the power supply.

48. The method of claim 47, wherein said step of subdividing the data passes the data through a sequencer to a plurality of first buffers, passes the data from each first buffer to a second sequencer, and divides the data in each second sequencer to subdata;

passing each subdata through a separate buffer and logical control to a disk drive in parallel for all the subdata from at least the second sequencer;

dividing the disk drives among a plurality of power groups for steady state driving, which power groups are different from the start-up groups and so that each power group contains disk drives provided with data respectively from all of the second sequencers, so that all the disk drives are divided

among the power groups without any one disk drive being in more than one power group and so that only one disk drive communicating subdata with a second sequencer is contained within one power group;

said subdividing, reading and writing, driving, dividing, starting up and repeating are conducted with respect to each of a plurality of power supplies and corresponding plurality of groups of the disk drives; and

parity dividing the disk drives into a plurality of parity groups so that the parity groups contain disk drives different from, respectively, the power groups and the start-up groups.

49. The method of claim 48, wherein each parity group includes a master disk;

wherein said step of dividing the disk drives provides the first start-up group to contain all of the master disk drives;

providing a plurality of power supplies, with each power supply supplying power to only a single disk drive of each and every parity group; and

wherein said steps of subdividing, reading and writing, driving, dividing, starting up, and repeating are conducted with respect to all the disk drives provided with power by each power supply.

50. A disk system, comprising:

a plurality of disk drives;

means for subdividing serial data to be written into a plurality of units of subdivided data;

means for reading and writing the units of subdivided data in parallel with respect to the plurality of disk drives;

means for driving the plurality of disk drives with a power source providing a steady state current during steady state driving of the disk drives;

means for dividing the disk drives into a plurality of start-up groups so that at least a first one of the start-up groups has a plurality of the disk drives;

means for, at the time of power-on, starting up the first one of the start-up groups with current from the power source for a first period of time until the first start-up group attains a steady state condition;

means for, at about the end of the first period of time, starting up a second one of the start-up groups with current from the power source for a second period of time until the second start-up group attains a steady state condition while continuing to rotate the first one of the start-up groups at steady state; and

means for repeating the starting sequentially for the remaining, if any, start-up groups until all of the disk drives have attained steady state driving.

51. An array disk system for use with a host device, comprising:

a plurality of disk drives in an array and each having read/write heads;

controller means for controlling disk rotation, read/write head position and data processing, for conducting parallel read/write of data by combining/subdividing data transferred with respect to the host device, and for simultaneously exchanging the subdivided data in parallel with respect to the individual disk drive;

said disk drives being divided into a plurality of parity groups; and

each parity group including a master disk;

means responsive to a start up signal for starting up all of the master disk drives as a part of a first start up group, and thereafter starting up the remaining disk drives after the first group of disk drives has substantially reached steady state condition; and

means for controlling the rotational speed of the disk drives other than the master disk drives with reference to the master disk drives, for each parity group.

52. The array disk system according to claim 51, wherein said controller means includes buffers and is provided with data processor means which store subdivided data simultaneously transferred to the respective groups in the buffers within the respective groups and conducts read/write processing of the data

in accordance with an offset sufficient to prevent overlap of seek operations of the heads.

53. The system of claim 52, wherein said controller means includes sequencers, and subdivides the data through a sequencer to a first plurality of the buffers, passes the data from each first buffer to a second sequencer, divides the data in each second sequencer to subdata and passes each subdata through a separate second one of the buffers to a disk drive in parallel for all the subdata from at least the second sequencer.

54. The system of claim 53, including a plurality of power supplies;

wherein the disk drives are divided among a plurality of power groups for steady state driving respectively by the power supplies, which power groups are different from the start-up groups and so that each power group contains disk drives provided with data respectively from all of the second sequencers, so that all the disk drives are divided among the power groups without any one disk drive being in more than one power group and so that only one disk drive communicating subdata with a second sequencer is contained within one power group.

55. The device of claim 54, wherein the first start up group for each power supply has a number of disk drives not exceeding the current capacity of the power supply divided by the ratio of start up current to steady state current of a single disk drive.